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In re the Application of:

Kyung-geun LEE et al.

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For: OPTICAL DISK HAVING TRACKING POLARITY INFORMATION, AND APPARATUSES AND METHODS FOR RECORDING AND REPRODUCING USER DATA ON THE SAME

SUBMISSION OF VERIFIED TRANSLATION OF KOREAN PATENT APPLICATION

Commissioner for Patents
PO Box 1450
Alexandria, VA 22313-1450

Sir:

In accordance with the provisions of 37 C.F.R. § 1.78, the applicants submit herewith a translation of Korean Patent Application No.2002-67968 and a statement from the translator.

If there are any additional fees associated with filing of this Submission, please charge the same to our Deposit Account No. 503333.

Respectfully submitted,

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Date: 7/11/07

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CERTIFICATION OF TRANSLATION

I, ***Eun-mee Won***, an employee of Y.P. LEE, MOCK & PARTNERS of Koryo Bldg., 1575-1 Seocho-dong, Seocho-gu, Seoul, Republic of Korea, hereby declare under penalty of perjury that I understand the Korean language and the English language; that I am fully capable of translating from Korean to English and vice versa; and that, to the best of my knowledge and belief, the statement in the English language in the attached translation of ***Korean Patent Application No. 10-2002-0067968*** consisting of 20 pages, have the same meanings as the statements in the Korean language in the original document, a copy of which I have examined.

Signed this 11th day of July 2007

Eunmee Won

ABSTRACT

[Abstract of the Disclosure]

Provided are an optical disc containing tracking polarity information, and apparatuses and methods for recording and reproducing user data on the same. The optical disc includes a clamping area, a lead-in area, a data area, and a burst cutting area (BCA) which is present between the clamping area and the lead-in area and in which information regarding the optical disc is recorded, the information being read before performing tracking in the data area. Accordingly, it is possible to obtain the tracking polarity information and/or reflectivity information without trial and error and directly record or reproduce user data in a data area of the optical disc.

[Representative Drawings]

FIG. 7

SPECIFICATION

[Title of the Invention]

OPTICAL DISC HAVING TRACKING POLARITY INFORMATION, AND APPARATUSES AND METHODS FOR RECORDING AND REPRODUCING USER DATA ON THE SAME

[Brief Description of the Drawings]

FIG. 1 is a schematic block diagram of an optical disc recording apparatus according to a preferred embodiment of the present invention.

FIG. 2 is a schematic block diagram of an optical disc reproducing apparatus according to a preferred embodiment of the present invention.

FIG. 3 is a schematic block diagram of an optical disc according to a preferred embodiment of the present invention.

FIG. 4 is a schematic block diagram of an optical disc according to another embodiment of the present invention.

FIG. 5 is a schematic block diagram of an optical disc according to still another embodiment of the present invention.

FIG. 6A illustrates a data structure of a burst cutting area (BCA) of an optical disc according to a preferred embodiment of the present invention.

FIG. 6B illustrates a data structure of a BCA of an optical disc according to another embodiment of the present invention.

FIG. 7 illustrates a data structure of information recorded on a BCA of an optical disc according to a preferred embodiment of the present invention.

FIG. 8 is a flowchart illustrating a method of reproducing data from an optical disc according to a preferred embodiment of the present invention.

FIG. 9 is a flowchart illustrating a method of reproducing data from an optical disc according to another embodiment of the present invention.

[Detailed Description of the Invention]

[Object of the Invention]

[Technical Field of the Invention and Related Art Prior to the Invention]

The present invention relates to an optical disc, and more particularly, to an optical disc having at least one recording layer, and apparatuses and methods for recording and reproducing data on the same.

Compact discs (CDs) and digital versatile discs (DVDs) are the most popular data storage media. In general, user data is recorded as pits on a recording layer of a read-only optical disc and recorded by changing the phase of a phase change material (PCM) on a recording layer of a rewritable optical disc which is covered with the PCM.

A pickup, which is included in an optical disc reproducing apparatus, detects the precise position of a track in which user data is recorded, receives a laser beam reflected from the track, and reads the user data from the laser beam. A signal that the pickup uses to detect the position of a desired track is called a tracking signal. The tracking signal is obtained when a photo diode, which has a plurality of light receiving parts, receives a laser beam, signals are generated from lights received by the respective light receiving parts, and then, the signals are added together or subtracted from each other. The tracking signal curves like an S shape and its right and left sides, which are divided with respect to the central point of the tracking signal, have opposite polarities.

The polarities of the tracking signal change according to the type of an optical disc or the physical characteristics of a recording layer on the optical disc, such as the physical characteristics of a pit or a track. In other words, the polarities of the tracking signal change from (-) to (+) and from (+) to (-) according to the type of an optical disc or the physical characteristics of the recording layer. Therefore, when an optical disc is loaded into a conventional optical disc reproducing apparatus, the apparatus finds out the polarity of a tracking signal by trial and error, detects the position of a track in which user data is recorded based on the polarity, and reads the user data from the track.

That is, the conventional optical disc reproducing apparatus spends considerable time in detecting the polarity of the tracking signal before reading the user data, thereby delaying reproduction of the user data.

Meanwhile, the reflectivity of an optical disc is a ratio of the power of a laser beam reflected from a recording layer of the optical disc to the power of a laser beam incident on the recording layer. The reflectivity also depends on the type of the optical disc or the physical characteristics of the recording layer, and therefore, a conventional optical disc reproducing apparatus detects the reflectivity by trial and error.

[Technical Goal of the Invention]

The present invention provides an optical disc from which information regarding the polarity of a tracking signal and/or the reflectivity is easily recognized, and apparatuses and methods for recording and reproducing information on the same.

[Structure of the Invention]

According to an aspect of the present invention, there is provided an optical disc comprising a clamping area; a lead-in area; a data area; and a burst cutting area (BCA) which is present between the clamping area and the lead-in area and in which information regarding the optical disc is recorded, the information being read before performing tracking in the data area.

It is preferable that the information regarding the optical disc is at least one of tracking polarity information and reflectivity information, and the tracking polarity information and the reflectivity information are recorded with a pattern of crystalline or non-crystalline marks.

It is preferable that recording of the tracking polarity information begins at leading bytes in the BCA and is repeatedly recorded several times.

It is preferable that the first two bits of the leading bytes of the tracking polarity information express the identifiers of the respective tracking polarity information that is repeatedly recorded several times, and the other six bits express information.

It is preferable that one of the six bits expresses flag information that indicates whether or not other information is recorded in the BCA, and the other five bits of the six bits express the tracking polarity information that indicates the polarity of a tracking signal related to each recording layer of the optical disc.

According to another aspect of the present invention, there is provided an optical disc comprising a first recording layer in which a first lead-in area, a first data area, and a first lead-out area are formed; and a second recording layer in which a second lead-in area, a second data area, and a second lead-out area are formed, wherein at least one of the first and second recording layers includes a BCA in which information regarding the optical disc is recorded, the information being read before performing tracking in the first and second data areas.

It is preferable that the information regarding the optical disc is at least one of tracking polarity information and reflectivity information, and the tracking polarity information and the reflectivity information are recorded with a pattern of crystalline or non-crystalline marks.

It is preferable that the recording of the tracking polarity information begins in leading bytes in the BCA and is repeatedly recorded several times.

According to yet another aspect of the present invention, there is provided a method of recording information on an optical disc that has at least one recording layer, the method comprising recording at least one of tracking polarity information and reflectivity information in a BCA of the recording layer.

According to still another aspect of the present invention, there is provided a method of reproducing information on an optical disc which has at least one recording layer, the method comprising reading tracking polarity information in a BCA of the recording layer, and analyzing the read tracking polarity information, performing tracking in the recording layer of the optical disc using the analysis result, and recording or reproducing user data on the optical disc.

According to still another aspect of the present invention, there is provided a method of reproducing information on an optical disc which has at least one recording

layer, the method comprising reading reflectivity information in a BCA of the recording layer; and analyzing the read reflectivity information, adjusting the write or read power of a laser beam using the analysis result, and recording or reproducing user data on the optical disc.

According to still another aspect of the present invention, there is provided an optical disc recording apparatus comprising a controller which creates at least one of tracking polarity information and reflectivity information, and a recording unit that records the information created by the controller in a BCA of an optical disc.

According to still another aspect of the present invention, there is provided an optical disc reproducing apparatus comprising a reading unit which reads at least one of tracking polarity information and reflectivity information from a BCA of an optical disc, and a controller which analyzes the information read by the reading unit, and records or reproduces user data on optical disc using the analysis result.

Exemplary embodiments of the present invention will now be described in detail with reference the accompanying drawings.

FIG. 1 is a schematic block diagram of an optical disc recording apparatus according to a preferred embodiment of the present invention. Referring to FIG. 1, the recording apparatus includes a recording unit 1 and a controller 2 so as to record information regarding the polarity of a tracking signal and/or the reflectivity of an optical disc 100 on a burst cutting area (BCA) on the optical disc 100. The controller 2 creates the information regarding the polarity of a tracking signal and/or reflectivity of the BCA and the recording unit 1 records at least one of the tracking polarity information and the reflectivity information on the BCA. Thus, the BCA of the optical disc 100 according to the present invention contains the tracking polarity information and/or the reflectivity information.

FIG. 2 is a schematic block diagram of an optical disc reproducing apparatus according to a preferred embodiment of the present invention. Referring to FIG. 2, the reproducing apparatus includes a reading unit 4 and a controller 5. The reading unit 4 reads tracking polarity information and/or reflectivity information from a BCA on an

optical disc 100 according to the present invention and provides the result to the controller 5. Then, the controller 5 analyzes the tracking polarity information and/or the reflectivity information and reproduces user data from the optical disc 100 based on the analysis result.

The recording apparatus of FIG. 1 is an apparatus used in a mastering process by a disc manufacturer. The reproducing apparatus of FIG. 2 is an apparatus for reproducing the tracking polarity information and/or the reflectivity information, not user data, from the BCA. Thus, the reproducing apparatus of FIG. 2 can be included in both an optical disc recording apparatus and an optical disc reproducing apparatus, because the reproduction of the above information can be carried out when recording or reproducing user data on an optical disc.

FIG. 3 is a schematic block diagram of an optical disc 100 according to a preferred embodiment of the present invention. Referring to FIG. 3, a first recording layer $\ell 0$ is formed on the optical disc 100. The first recording layer $\ell 0$ includes a clamping area *C*, a BCA *B*, a lead-in area *LI*, and a lead-out area *LO*. The clamping area *C* is an area that is pressurized by a clamping tool in order to clamp the optical disc 100. In general, the clamping area *C* is circular band shaped and formed in an inner portion of the optical disc 100. The BCA *B* is an area in which the tracking polarity information and/or the reflectivity information is recorded. The particulars of the optical disc 100, such as its serial number and manufacturing date, may be further recorded in the BCA *B*. A data area in which user data is recorded, is present between the lead-in area *LI* and the lead-out area *LO*. If the first recording layer $\ell 0$ is formed of a phase change material (PCM), it is preferable that the tracking polarity information and/or the reflectivity information is recorded with a pattern of crystalline and/or non-crystalline marks. A method of recording information in the BCA *B* is disclosed in Korean Patent Application No. 2001-47957 entitled "Optical Disc and Methods for Recording and Reproducing Essential Information of Optical Disc", also filed by the present applicant.

FIG. 4 is a schematic block diagram of an optical disc 100 according to another

embodiment of the present invention. Referring to FIG. 4, a first recording layer $\ell 0$ and a second recording layer $\ell 1$ are formed on the optical disc 100. Each of the first recording layer $\ell 0$ and the second recording layer $\ell 1$ includes a clamping area *C*, a lead-in area *LI*, and a lead-out area *LO*. A data area in which user data is recorded, is present between the lead-in area *LI* and the lead-out area *LO*. The clamping area *C*, the lead-in area *LI*, and the lead-out area *LO* are the same as those explained with respect to FIG. 3, and therefore, their descriptions will not be repeated here. Further, a BCA *B* is present between the clamping area *C* and the lead-in area *LI* of the first recording layer $\ell 1$. The tracking polarity information and/or the reflectivity information is recorded in the BCA *B* according to the present invention. The particulars of the optical disc 100, such as its serial number and manufacturing date, may be further recorded in the BCA *B*. If the first recording layer $\ell 0$ is formed of a phase change material (PCM), it is preferable that the tracking polarity information and/or the reflectivity information is recorded with a pattern of crystalline and/or non-crystalline marks. A method of recording information in the BCA *B* is disclosed in Korean Patent Application No. 2001-47957 entitled "Optical Disc and Methods for Recording and Reproducing Essential Information of Optical Disc", also filed by the present applicant.

FIG. 5 is a schematic block diagram of an optical disc 100 according to still another embodiment of the present invention. Referring to FIG. 5, a first recording layer $\ell 0$ and a second recording layer $\ell 1$ are formed on the optical disc 100. Each of the first recording layer $\ell 0$ and the second recording layer $\ell 1$ includes a clamping area *C*, a lead-in area *LI*, and a lead-out area *LO*. A data area in which user data is recorded, is present between the lead-in area *LI* and the lead-out area *LO*. The clamping area *C*, the lead-in area *LI*, and the lead-out area *LO* are the same as those explained with respect to FIG. 3, and therefore, their descriptions will not be repeated here. According to this embodiment, a BCA *B* is formed on the second recording layer $\ell 1$, unlike in FIG. 4 in which the BCA *B* is present on the first recording layer $\ell 0$. That is, the BCA *B* of FIG. 5 is present between the clamping area *C* and the lead-in area *LI* of the second recording layer $\ell 1$. If the second recording layer $\ell 1$ is

formed of a phase change material (PCM), it is preferable that the tracking polarity information or reflectivity information are/is recorded with a pattern of crystalline and/or non-crystalline marks. A method of recording information in the BCA *B* is disclosed in Korean Patent Application No. 2001-47957 entitled "Optical Disc and Methods for Recording and Reproducing Essential Information of Optical Disc", also filed by the present applicant.

In conclusion, the optical disc 100 of FIG. 5 is different from that of FIG. 4 in that the BCA *B* is present in the second recording layer, not the first recording layer.

FIG. 6A illustrates a data structure of a BCA of the optical disc 100 according to a preferred embodiment of the present invention. Referring to FIG. 6A, the tracking polarity information is recorded in the BCA according to the present invention. The tracking polarity information provides the polarity of a tracking signal related to the optical disc 100. The tracking signal curves like an S shape and its right and left sides, which are divided with respect to the central point of the tracking signal, have opposite polarities. The polarity of the tracking signal changes according to the type of the optical disc 100, or the physical characteristics of a recording layer such as the physical characteristics of a pit or a track. In other words, the polarities of the tracking signal change from (-) to (+) and (+) to (-) according to the type of the optical disc 100 or the physical characteristics of the recording layer. The particulars of the optical disc 100 may be further recorded in the BCA *B*, as well as the tracking polarity information.

FIG. 6B illustrates a data structure of a BCA of the optical disc 100 according to another embodiment of the present invention. The tracking polarity information and/or the reflectivity information is recorded in the BCA according to the present invention. Here, the tracking polarity information is as described with reference to FIG. 6A. The reflectivity information provides the reflectivity of the optical disc 100, which is a ratio of the power of a laser beam reflected from a recording layer of the optical disc 100 to the power of a laser beam incident on the recording layer. The reflectivity also changes according to the type of the optical disc 100 or the physical characteristics of the recording layer.

Meanwhile, the tracking polarity information is recorded in both the BCAs of FIGS. 6A and 6B, but only the reflectivity information can be recorded if needed.

FIG. 7 illustrates a data structure of information recorded in a BCA of the optical disc 100 according to a preferred embodiment of the present invention. In detail, FIG. 7 shows an example of a BCA in the optical disc 100 having two recording layers as shown in FIGS. 4 and 5. The tracking polarity information is repeatedly recorded four times in the BCA and the recording begins at leading bytes of the BCA. The first two bits *b1b0* are identifiers of the respective information that is repeatedly recorded. If the first two bits *b1b0* are 00, it indicates that first tracking polarity information is recorded in the BCA. If the first two bits *b1b0* are 01, it indicates that second tracking polarity information is recorded in the BCA. If the first two bits *b1b0* are 10, it indicates that third tracking polarity information is recorded in the BCA. If the first two bits *b1b0* are 11, it indicates that fourth tracking polarity information is recorded in the BCA. Repetitive recording of information increases the robustness of information. Even if an error occurs in one of the repeated recordings, it is possible to read desired information from the other recordings. The other six bits *b7b6b5b4b3b2* provide information. The bit *b2* contains flag information indicating whether or not other information, i.e., the particulars of the optical disc 100, is recorded in the BCM. If the bit *b2* is 0, this indicates that the other information is not recorded in the BCM. If the bit *b2* is 1, this indicates that the other information is recorded in the BCM. The bits *b7b6b5b4b3* represent tracking polarity information and can be defined as follows:

00000: first recording layer = type A, second recording layer = type B
00001: first recording layer = type B, second recording layer = type A
00010: first recording layer = second recording layer = type A
00011: first recording layer = second recording layer = type B

For instance, when the other information is not recorded in the BCA, and the polarities of tracking signals related to the first and second recording layers are type B

and type A, respectively, the six bits *b7b6b5b4b3b2* is expressed as '000010'. When the other information such as the particulars of the optical disc 100 is recorded in the BCA, and both the polarities of tracking signals related to the first and second recording layers are type A, the six bits *b7b6b5b4b3b2* is expressed as '000101'.

If 1 byte is not enough to express the tracking polarity information, for example, if the number of recording layers is more than 2, it is possible to express the tracking polarity information using additional bits in addition to the 1 byte.

When the optical disc 100 is loaded into a disc drive of an optical disc reproducing apparatus, the disc drive easily accesses leading bytes of the BCA so as to read the tracking polarity information and/or the reflectivity information. Accordingly, it is preferable that recording of the tracking polarity information and/or reflectivity information begins on the leading bytes of the BCA.

A method of reproducing data from the optical disc 100 according to the present invention will now be described. As mentioned above, data that is reproduced using the method is not user data, but tracking polarity information and/or the reflectivity information recorded in a BCA of the optical disc 100. The reproduction of such data can be performed both when recording and reproducing user data in a data area.

FIG. 8 is a flowchart illustrating a method of reproducing data from the optical disc 100 according to a preferred embodiment of the present invention. Referring to FIG. 8, when the optical disc 100 is loaded into a disc drive of the reproducing apparatus of FIG. 2 in step 801, an optical pickup included in the disc drive reads tracking polarity information from a BCA of the optical disc 100 in step 802. The reproducing apparatus (or the disc drive) performs tracking on the optical disc 100 using the read tracking polarity information without trial and error, and records or reproduces user data in a data area of the optical disc 100, in step 803. In other words, the optical pickup provides the tracking polarity information to the disc drive, and then, the disc drive controls the optical pickup using the information to perform recording or reproducing user data on the optical disc 100.

FIG. 9 is a flowchart illustrating a method of reproducing data from the optical

disc 100 according to another embodiment of the present invention. Referring FIG. 9, when the optical disc 100 is loaded into a disc drive of the reproducing apparatus of FIG. 2 in step 901, an optical pickup included in the disc drive reads reflectivity information from a BCA of the optical disc 100 in step 902. The reproducing apparatus (or the disc drive) adjusts the write/read power of a laser beam using the read reflectivity information without trial and error, and records or reproduces user data in a data area of the optical disc 100, in step 903. In other words, the optical pickup provides the reflectivity information to the disc drive, and then, the disc drive controls the optical pickup using the information to perform recording or reproducing user data on the optical disc 100.

[Effect of the Invention]

As described above, tracking polarity information and/or reflectivity information is recorded in a BCA of an optical disc according to the present invention. Accordingly, it is possible to obtain the tracking polarity information and/or reflectivity information without trial and error and directly record or reproduce user data in a data area of the optical disc.

What is claimed is:

1. An optical disc comprising:

a clamping area;

a lead-in area;

a data area; and

a burst cutting area (BCA) which is present between the clamping area and the lead-in area and in which information regarding the optical disc is recorded, the information being read before performing tracking in the data area.

2. The optical disc of claim 1, wherein the information regarding the optical disc is at least one of tracking polarity information and reflectivity information.

3. The optical disc of claim 2, wherein the tracking polarity information and the reflectivity information are recorded with a pattern of crystalline or non-crystalline marks.

4. The optical disc of claim 2, wherein recording of the tracking polarity information begins at leading bytes in the BCA.

5. The optical disc of claim 4, wherein the tracking polarity information is repeatedly recorded several times.

6. The optical disc of claim 4, wherein the first two bits of the leading bytes of the tracking polarity information express the identifiers of the respective tracking polarity information that is repeatedly recorded several times, and the other six bits express information.

7. The optical disc of claim 6, wherein one of the six bits expresses flag information that indicates whether or not other information is recorded in the BCA.

8. The optical disc of claim 7, wherein the other five bits of the six bits express the tracking polarity information that indicates the polarity of a tracking signal related to each recording layer of the optical disc.

9. The optical disc of claim 1, wherein the clamping area, the lead-in area, and the data area are formed in each recording layer of the optical disc.

10. An optical disc comprising:

a first recording layer in which a first lead-in area, a first data area, and a first lead-out area are formed; and

a second recording layer in which a second lead-in area, a second data area, and a second lead-out area are formed,

wherein at least one of the first and second recording layers includes a BCA in which information regarding the optical disc is recorded, the information being read before performing tracking in the first and second data areas.

11. The optical disc of claim 10, wherein the information regarding the optical disc is at least one of tracking polarity information and reflectivity information.

12. The optical disc of claim 11, wherein the tracking polarity information and the reflectivity information are recorded with a pattern of crystalline or non-crystalline marks.

13. The optical disc of claim 12, wherein the recording of the tracking polarity information begins in leading bytes in the BCA.

14. The optical disc of claim 13, wherein the tracking polarity information is repeatedly recorded several times.

15. A method of recording information on an optical disc that has at least one recording layer, the method comprising recording at least one of tracking polarity information and reflectivity information in a BCA of the recording layer.

16. A method of reproducing information on an optical disc which has at least one recording layer, the method comprising:

reading tracking polarity information in a BCA of the recording layer; and

analyzing the read tracking polarity information, performing tracking in the recording layer of the optical disc using the analysis result, and recording or reproducing user data on the optical disc.

17. A method of reproducing information on an optical disc which has at least one recording layer, the method comprising:

reading reflectivity information in a BCA of the recording layer; and

analyzing the read reflectivity information, adjusting the write or read power of a laser beam using the analysis result, and recording or reproducing user data on the optical disc.

18. An optical disc recording apparatus comprising:

a controller which creates at least one of tracking polarity information and reflectivity information; and

a recording unit that records the information created by the controller in a BCA of an optical disc.

19. An optical disc reproducing apparatus comprising:

a reading unit which reads at least one of tracking polarity information and reflectivity information from a BCA of an optical disc; and

a controller which analyzes the information read by the reading unit, and records or reproduces user data on optical disc using the analysis result.

FIG. 1

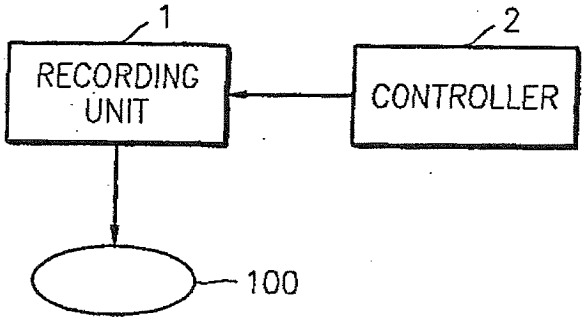

1
RECORDING UNIT
2
CONTROLLER
100

FIG. 2

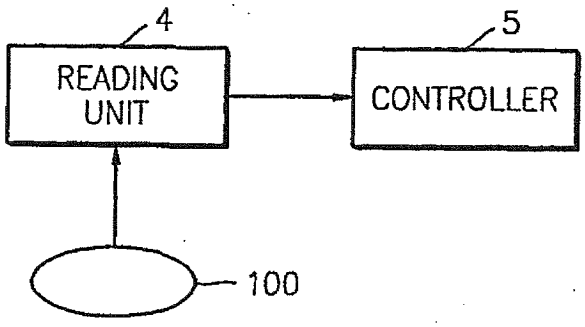

4
READING UNIT
5
CONTROLLER
100

FIG. 3

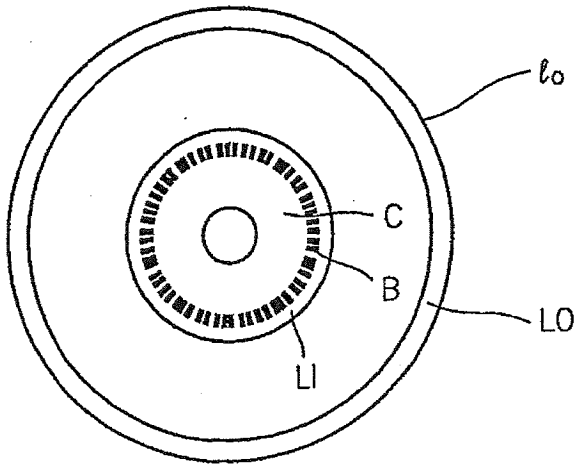


FIG. 4A

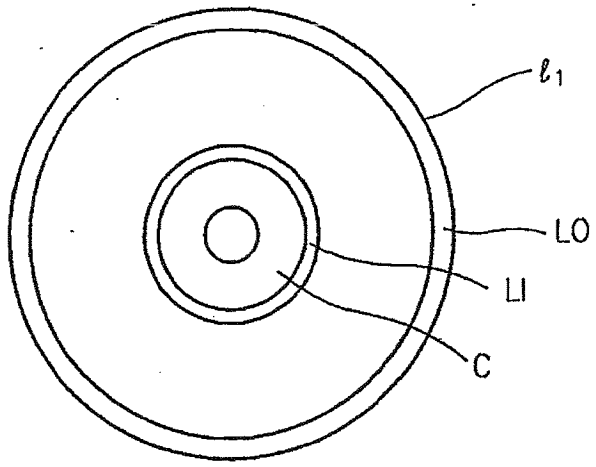


FIG. 4B

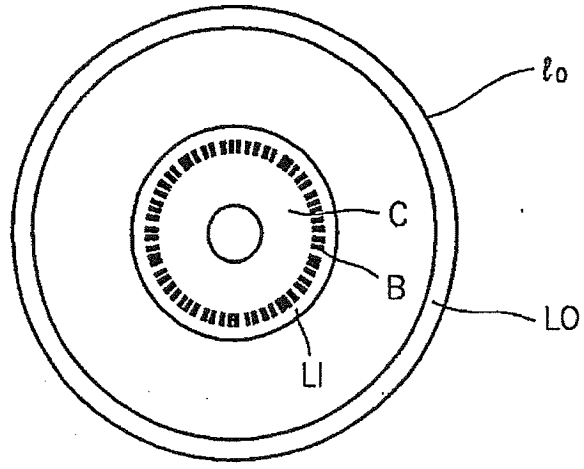


FIG. 5A

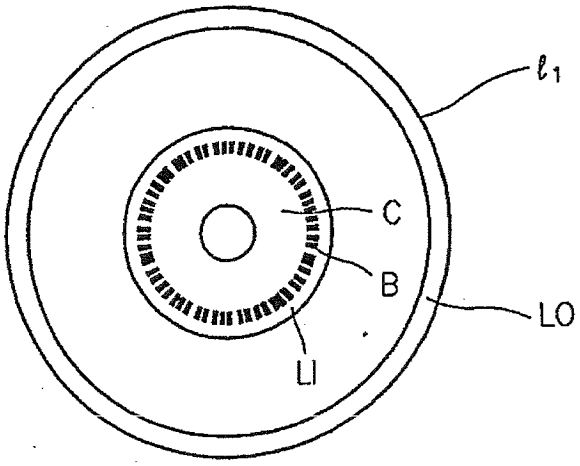


FIG. 5B

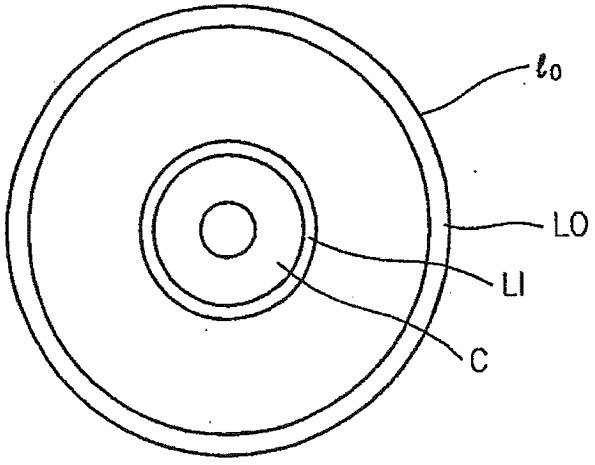


FIG. 6A

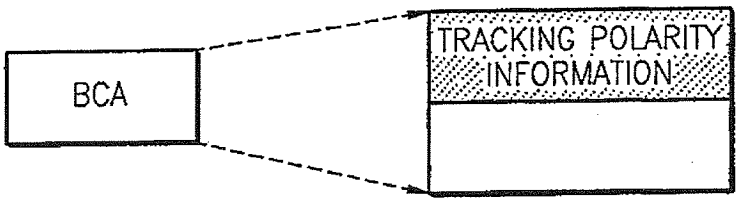


FIG. 6B

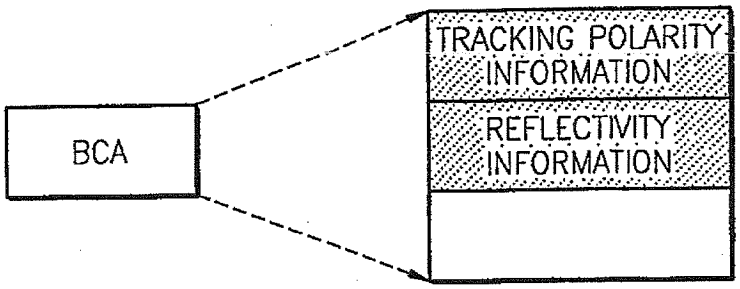


FIG. 7

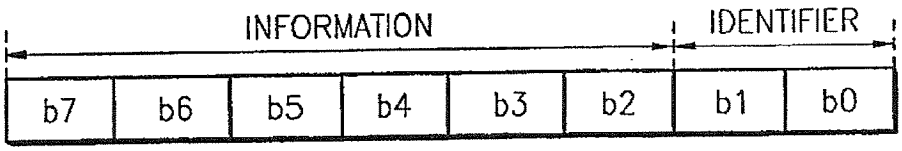


FIG. 8

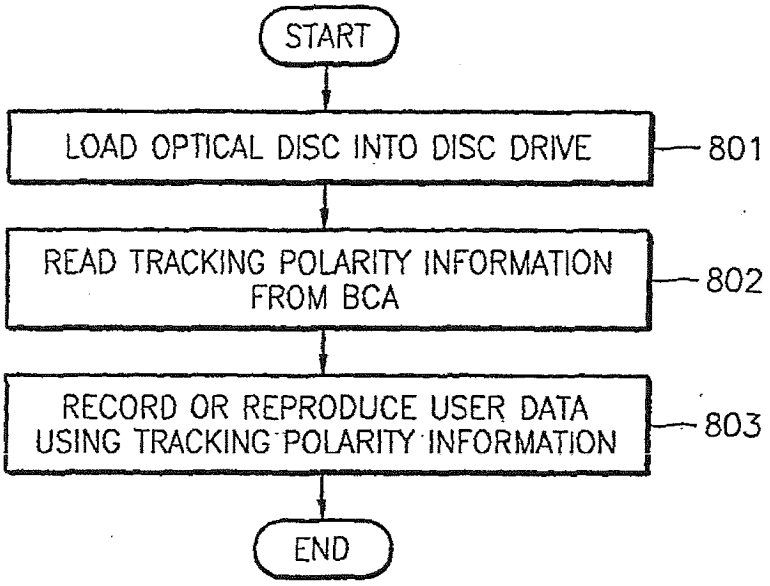
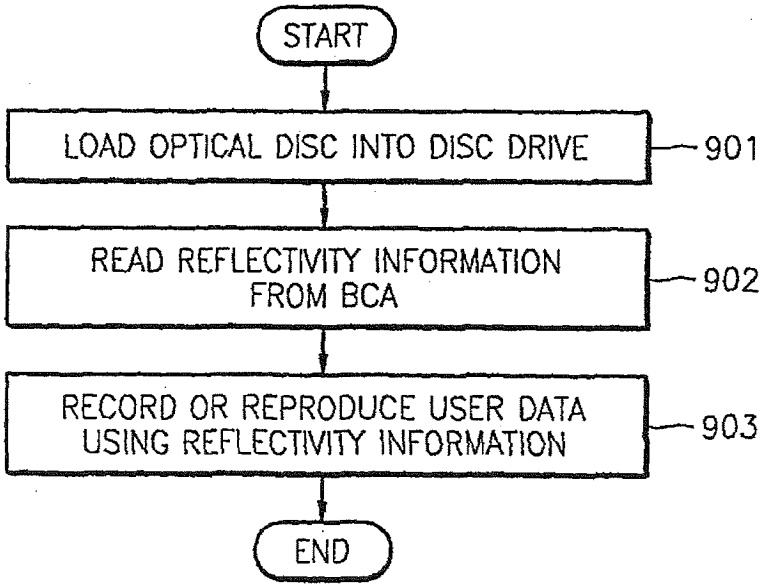

START
LOAD OPTICAL DISC INTO DISC DRIVE
801
READ TRACKING POLARITY INFORMATION FROM BCA
802
RECORD OR REPRODUCE USER DATA USING TRACKING POLARITY INFORMATION
803
END

FIG. 9


START
LOAD OPTICAL DISC INTO DISC DRIVE
901
READ REFLECTIVITY INFORMATION FROM BCA
902
RECORD OR REPRODUCE USER DATA USING REFLECTIVITY INFORMATION
903
END